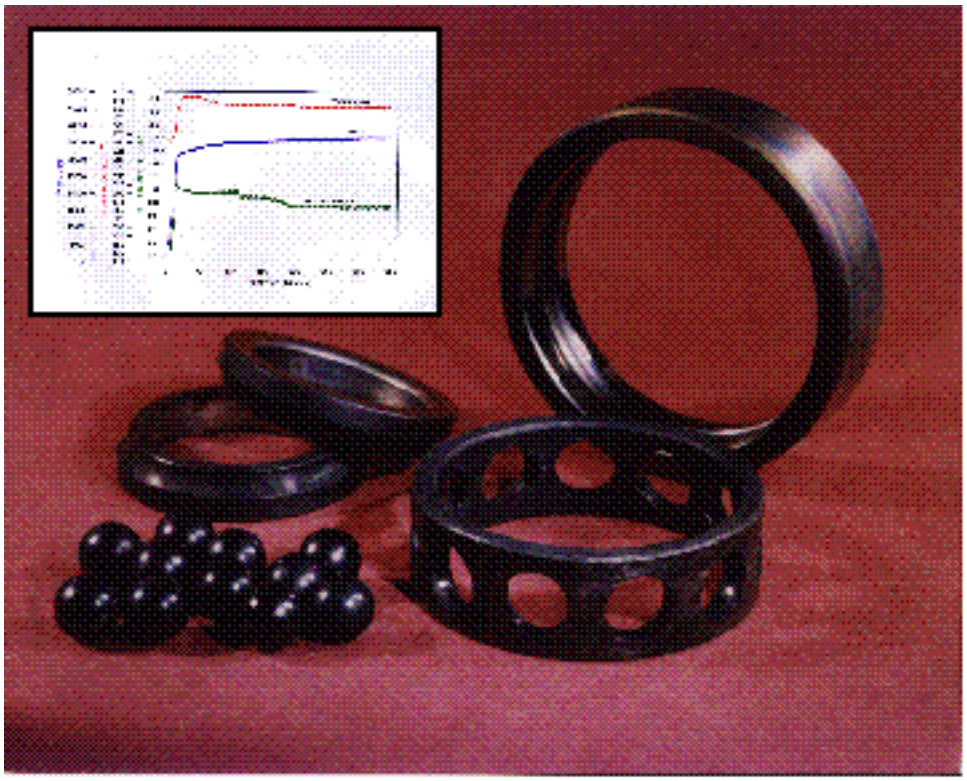
LIGHT WEIGHT LUBRICATION SYSTEM REDUCES EXPENDABLE ENGINE WEIGHT



Payoff

Utilization of a light weight lubrication system (less than 5 pounds) in an expendable engine for unmanned air vehicles and cruise missiles will eliminate 25 pounds of engine hardware. This system, using rolling element bearings, carbon-carbon cages (shown above right front) and vapor phase lubrication, will result in improved engine performance (through reduced cooling requirements) and reduced engine cost (through lower parts count).

Accomplishment

A carbon-carbon (C-C) composite bearing cage was tested by the Propulsion Directorate for thirty-two hours in 30 millimeter bore ball bearings at speeds of 35,000 revolutions per minute, temperatures of 750°F to 950°F, and thrust loads of 100 to 400 lbs. This is the first time that rolling element bearings have achieved stable operation at these extreme conditions.

Background

The development of high speed bearings that operate beyond the temperature limits of

conventional synthetic liquid lubricants has been a research objective for more than forty years. In the early 1990's, in-house research performed in the Propulsion Directorate edged closer to this objective by applying organic phosphate vapors to high temperature bearing surfaces. This method proved successful for high speed bearings; however, lubrication of the steel bearing cage still posed a problem. Based on their previous success with phenolic (thermosetting plastic) bearing cages at low temperatures, and knowledge of the high temperature properties of C-C composites, Directorate in-house researchers postulated that C-C composites would be an ideal temperature bearing cage material. This material's properties include a low coefficient of friction, extremely low wear rates, high thermal conductivity, high temperature strength, low density, and good damping characteristics. Collaboration with the Materials Directorate identified B.F. Goodrich Aerospace of Santa Fe Springs CA as the most promising source for C-C bearing cage material. During the period of June 1995 to February 1996, a single C-C bearing cage accumulated over thirty-two hours of testing. This technology has dual use potential where high speed, high temperature bearings are required.